Customer No.: 31561
Docket No.: 10958-US-PA
Application No.: 10/604,651

REMARKS

Present Status of the Application

The Office Action rejected claims 1 and 20-28 under 35 U.S.C. 102(e), as being anticipated by Takayama (U.S. 6,610,142). The Office Action also rejected claims 2-12 and 13-19 under 35 U.S.C. 103(a) as being unpatentable over Takayama in view of Jen (JJAP Part 2: Letters 1991, 33(7B), L997-L979) and Luan (Jour. Of Appl. Phys. 1990, 68(7), 3445-3450).

Applicants have amended claims 1-2, 4, 10-11 and 13 and canceled claims 3, 5-6, 12 and 14-15 to more clearly define the present invention. The limitation added in claims 1 and 10 are described in paragraphs [0019] and [0030], and no new matter is entered. After entry of the foregoing amendments, claims 1-2, 4, 7-11, 13 and 16-28 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Rejections of 35 U.S.C 102 (e)

Applicants respectfully traverse the rejection of claims 1 and 20-28 under 35 U.S.C. 102(e) because Takayama (U.S. 6,610,142) does not teach each and every element in the claims.

> "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "See M.P.E.P. 2131, Latest Revision August 2006".

The present invention is in general related to a method of forming a low temperature polysilicon thin film transistor as claim 1 recites:

Claim 1. A method of forming a low temperature polysilicon thin film transistor, comprising the steps of:

forming an amorphous silicon layer over a substrate;

performing a plasma treatment to the amorphous silicon layer, ***wherein the plasma treatment is selected from nitrous oxide (N_2O) plasma, ammonia (NH_3) plasma or hydrogen (H_2) plasma***;

transforming the amorphous silicon layer into a polysilicon layer;

patterning the polysilicon layer to form a plurality of island polysilicon layers;

forming a channel region and a doped source/drain region on each side of the channel region in each island polysilicon layer; and

forming a gate over each channel region, ***wherein the channel region composed of polysilicon has an adjusted threshold voltage determining from the plasma treatment.***

In the Tokayama reference, the plasma treatment is performed to a silicon oxide layer before the amorphous silicon layer is formed in Examples 1-5. In Example 6, as shown in Fig. 9A, a uniform aqueous film 907 is formed over the substrate and a portion of the amorphous silicon layer 904 exposed by the silicon layer 905 is in contact with the aqueous film 907 having catalyst elements therein. Next, the amorphous silicon layer 904 is recrystallized by heating. The amorphous layer in all of the Examples of the citation is not treated by a plasma. In addition, the citation discloses the nucleation sites are controlled by selectively exposing the amorphous

silicon film to a plasma or by applying a substance containing elements having a catalytic effect thereto in the abstract. According to the description of the abstract, the plasma is used for controlling the nucleation sites in the amorphous layer. However, the citation fails to teach that the amorphous silicon layer is treated by ***nitrous oxide (N_2O) plasma, ammonia (NH_3) plasma or hydrogen (H_2) plasma***. The citation also fails to teach the channel region composed of polysilicon has an adjusted threshold voltage determining from the plasma treatment as claim 1 recites.

For at least the foregoing reasons, Applicant respectfully submits Tokayama does not teach each and every element in claim 1, and thus independent claim 1 patently define over the prior art reference, and should be allowed. For at least the same reasons, dependent claims 2, 4, 7-9 patently define over the prior art as a matter of law, for at least the reason that these dependent claims contain all features of their respective independent claim.

Regarding to the rejection of claims 20-28, applicant respectfully submits Examiner may make a mistake because claims 20-28 are dependent to claim 10. However, independent claim 10 is not rejected under 35 U.S.C. 102 (e) but rejected under 35 U.S.C 103(a).

Rejections of 35 U.S.C 103 (a)

Applicants respectfully traverse the rejection of claims 2-12 and 13-19 under 103(a) as being unpatentable over Takayama (U.S. 6,610,142) in view of Jen (JJAP Part 2: Letters 1991,

33(7B), L997-L979) and Luan (Jour. Of Appl. Phys. 1990. 68(7). 3445-3450) because a prima facie case of obviousness has not been established by the Office Action.

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.
> The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).
> "See M.P.E.P. 2143, Latest Revision August 2006".

As discussed above, Tokayama fails to disclose, teach or suggest the amorphous silicon layer is treated by nitrous oxide (N_2O) plasma, ammonia (NH_3) plasma or hydrogen (H_2) plasma, and the channel region composed of polysilicon has an adjusted threshold voltage determining from the plasma treatment. Lurn and Jen fail to teach or suggest ***the amorphous silicon layer is treated by nitrous oxide (N_2O) plasma, ammonia (NH_3) plasma or hydrogen (H_2) plasma***, and ***the channel region composed of polysilicon has an adjusted threshold voltage determining from the plasma treatment.***

In details, in the Lurn reference, the NH_3 plasma treatment is performed to ***a gate nitride layer*** (see abstract, lines 1-2) ***but not to an amorphous silicon layer***. In addition, the NH_3 plasma treatment to a gate nitride layer can increase the threshold voltage of ***an amorphous***

silicon thin film transistor (see abstract). For an amorphous silicon thin film transistor, the channel region is composed of ***amorphous silicon*** that is well known to the one skilled in the art. However, in claim 1 of the present application, the plasma treatment is performed to an amorphous silicon layer, and then the treated amorphous silicon layer is transformed into a polysilicon layer. Therefore, the channel region of the low temperature polysilicon thin film transistor is composed of ***polysilicon***, and the channel region composed of polysilicon has an adjusted threshold voltage determining from the plasma treatment.

In the Jen reference, the N_2O plasma is used to treat the deposited SiOxNy/SiNx ***gate insulators*** (see abstract, line 1) ***but not to an amorphous silicon layer.*** In addition, the N_2O plasma treatment to the SiOxNy/SiNx gate insulator can make the ***a-Si:H thin film transistor*** have a smaller threshold voltage (see abstract). Similarly, for an a-Si:H thin film transistor, the channel region is composed of ***amorphous silicon*** that is well known to the one skilled in the art. However, in claim 1 of the present application, the plasma treatment is performed to an amorphous silicon layer, and then the treated amorphous silicon layer is transformed into a polysilicon layer. Therefore, the channel region of the low temperature polysilicon thin film transistor is composed of ***polysilicon***, and the channel region composed of polysilicon has an adjusted threshold voltage determining from the plasma treatment.

Therefore, both Lurn and Jen fail to teach or suggest the amorphous silicon layer is treated by nitrous oxide (N2O) plasma, ammonia (NH3) plasma or hydrogen (H2) plasma, and the channel region composed of polysilicon has an adjusted threshold voltage determining from

the plasma treatment. The three references (Tokayama, Lurn and Jen) combined do not teach or suggest each and every element in claim 1. Independent claim 1 patently define over the prior art references, and should be allowed. For at least the same reasons, dependent claims 2, 4, 7-9 patently define over the prior art as a matter of law, for at least the reason that these dependent claims contain all features of their respective independent claim.

The present invention also provides a method of forming a low temperature polysilicon thin film transistor as claim 10 recites:

Claim 10. A method of forming a low temperature polysilicon thin film transistor, comprising the steps of:

providing a substrate;

forming an amorphous silicon layer over the substrate;

performing a plasma treatment to the amorphous silicon layer, ***wherein the plasma treatment is selected from nitrous oxide (N_2O) plasma, ammonia (NH_3) plasma or hydrogen (H_2) plasma***;

performing a laser annealing process to transform the amorphous silicon layer into a polysilicon layer;

patterning the polysilicon layer to form a plurality of island polysilicon layers;

forming a gate insulation layer over the island polysilicon layers;

forming a channel region in each island polysilicon layer and a doped source/drain region on each side to the channel regions; and

forming a gate over the channel regions, ***wherein the channel region composed of polysilicon has an adjusted threshold voltage determining from the plasma treatment.***

As discussed above, Tokayama Lurn and Jen fail to disclose, teach or suggest the amorphous silicon layer is treated by nitrous oxide (N_2O) plasma, ammonia (NH_3) plasma or hydrogen (H_2) plasma, and the channel region composed of polysilicon has an adjusted threshold voltage determining from the plasma treatment. Claim 10 also comprises these limitations, and

thus the three references combined do not teach each and every element in claim 10. Applicant respectfully submits independent claim 10 patently define over the three prior art references, and should be allowed. For at least the same reasons, dependent claims 11, 13 and 16-28 patently define over the three prior art references as a matter of law, for at least the reason that these dependent claims contain all features of their respective independent claim.

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CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted,

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